

CLAIMS

1. A tunable cutting device comprising:

an object support platform defining an object position;

a cutting tool mount;

a cutting tool secured to said cutting tool mount;

a drive unit configured to oscillate said cutting tool along a cutting axis intersecting said object position; and

an oscillation frequency control configured to permit variation of an oscillation frequency of said drive unit as said cutting tool oscillates along said cutting axis.

2. A tunable cutting device as claimed in claim 1 wherein said tunable cutting device is configured to provide an indication of a cutting rate at which said cutting tool moves along said cutting axis.

3. A tunable cutting device as claimed in claim 2 wherein said oscillation frequency control is configured to permit simultaneous observation of said cutting rate and variation of said oscillation frequency.

4. A tunable cutting device as claimed in claim 3 wherein said variation of said oscillation frequency comprises one of a manual operation, an automated operation, and combinations thereof.

5. A tunable cutting device as claimed in claim 3 wherein said observation of said cutting rate comprises one of a visual observation, an audible observation, an automated observation, and combinations thereof.

6. A tunable cutting device as claimed in claim 2 wherein said oscillation frequency control is configured to permit variation of said oscillation frequency as a function of said cutting rate.

7. A tunable cutting device as claimed in claim 2 wherein said oscillation frequency control is configured to permit variation of said oscillation frequency from about 18 kHz to about 1000 kHz.

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8. A tunable cutting device as claimed in claim 2 wherein said oscillation frequency control is configured to permit variation of said oscillation frequency from about 20 kHz to about 41 kHz.

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9. A tunable cutting device as claimed in claim 2 wherein said oscillation frequency control is configured to permit variation of said oscillation frequency over a range of at least about 20 kHz.

10. A tunable cutting device as claimed in claim 2 wherein said oscillation frequency control is configured to permit variation of said oscillation frequency at increments of less than about 0.2 kHz.

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11. A tunable cutting device as claimed in claim 2 wherein said variation of said oscillation frequency is affected through manual control of a potentiometer.

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12. A tunable cutting device as claimed in claim 11 wherein said potentiometer comprises an externally accessible potentiometer.

13. A tunable cutting device as claimed in claim 2 wherein said variation of said oscillation frequency is affected through manual control of said oscillation frequency.

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14. A tunable cutting device as claimed in claim 2 wherein said variation of said oscillation frequency is affected through automatic control of said oscillation frequency.

15. A tunable cutting device as claimed in claim 2 wherein said indication of said cutting rate comprises a visual signal.

16. A tunable cutting device as claimed in claim 2 wherein said indication of said cutting rate comprises an audible signal

5 17. A tunable cutting device as claimed in claim 16 wherein said audible signal is generated from contact of said cutting tool with an object in said object position.

18. A tunable cutting device as claimed in claim 2 wherein said indication of said cutting rate comprises a visual signal and an audible signal.

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19. A tunable cutting device as claimed in claim 1 wherein said oscillation frequency control comprises a voltage controlled oscillator.

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20. A tunable cutting device as claimed in claim 19 wherein an output of said voltage controlled oscillator is coupled to said drive unit.

21. A tunable cutting device as claimed in claim 19 wherein said voltage controlled oscillator comprises electronic circuitry comprising a control voltage input section, a voltage controlled oscillator stage, and a power driver section.

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22. A tunable cutting device as claimed in claim 1 wherein said cutting tool defines a resonant frequency and said oscillation frequency control is configured to permit variation of said oscillation frequency across a frequency range including said resonant frequency of said cutting tool.

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23. A tunable cutting device as claimed in claim 1 wherein said cutting tool comprises one of a circular cutting tool, a rectangular cutting tool, a square cutting tool, a triangular cutting tool, and combinations thereof.

24. A tunable cutting device as claimed in claim 1 wherein said cutting tool mount is configured to permit removal and replacement of said cutting tool.

25. A tunable cutting device as claimed in claim 1 wherein said cutting tool further comprises a cutting height controller configured to adjust a position of said cutting tool along said cutting axis.

26. A tunable cutting device as claimed in claim 1 wherein said tunable cutting device comprises a cutting depth indicator configured to indicate a position of said cutting tool along said cutting axis.

27. A tunable cutting device as claimed in claim 26 wherein said cutting depth indicator is further configured to indicate a cutting rate at which said cutting tool moves along said cutting axis.

28. A tunable cutting device as claimed in claim 27 wherein said oscillation frequency control is configured to permit variation of said oscillation frequency as a function of said cutting rate indicated by said cutting depth indicator.

29. A tunable cutting device as claimed in claim 1 wherein said drive unit comprises a piezoelectric drive unit.

30. A tunable cutting device as claimed in claim 1 wherein said drive unit is configured to oscillate said cutting tool along said cutting axis at about 26 kHz.

31. A tunable cutting device as claimed in claim 1 wherein said object support platform defines an object support plane and said cutting axis is oriented substantially perpendicular to said object support plane.

32. A tunable cutting device as claimed in claim 1 wherein said object support platform and said drive unit are configured such that said cutting tool and said object are urged towards each other along said cutting tool axis as said cutting tool oscillates.

5 33. A tunable cutting device as claimed in claim 1 wherein said object support platform comprises a spring loaded platform.

34. A tunable cutting device as claimed in claim 1 wherein said object support platform comprises a hinged platform.

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35. A tunable cutting device as claimed in claim 1 wherein said object support platform comprises a magnetic base.

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36. A tunable cutting device as claimed in claim 1 wherein said object support platform comprises an object table configured to accommodate an object to be cut in a cutting slurry.

37. A tunable cutting device as claimed in claim 36 wherein said cutting tool further comprises a cutting slurry supply.

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38. A tunable cutting device comprising:

an object support platform defining an object position;

a cutting tool mount;

a cutting tool secured to said cutting tool mount and defining a resonant frequency;

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a drive unit configured to oscillate said cutting tool along a cutting axis intersecting said object position at a frequency of between about 20 kHz and about 41 kHz;

an oscillation frequency control configured to permit variation of an oscillation frequency of said drive unit as said cutting tool oscillates along said cutting axis, wherein

said oscillation frequency control comprises a voltage controlled oscillator coupled to said drive unit,

said oscillation frequency control is configured to permit variation of said oscillation frequency across a frequency range including said resonant frequency of said cutting tool,

said variation of said oscillation frequency is permitted over a range of at least about 20 kHz at increments of less than about 0.2 kHz, and

said variation of said oscillation frequency is affected through manual control of an externally accessible potentiometer; and

a cutting depth indicator configured to indicate a position of said cutting tool along said cutting axis, wherein

said cutting depth indicator is further configured to indicate a cutting rate at which said cutting tool moves along said cutting axis,

said oscillation frequency control is configured to permit variation of said oscillation frequency as a function of said cutting rate indicated by said cutting depth indicator,

said oscillation frequency control is configured to permit simultaneous observation of said cutting rate and variation of said oscillation frequency

39. A method of operating a tunable cutting device, said method comprising:

positioning an object on an object support platform of said tunable cutting device so as to define an object position;

securing a cutting tool to a cutting tool mount of said device;

initiating oscillation of a drive unit configured to oscillate said cutting tool along a cutting axis intersecting said object position;

engaging said oscillating cutting tool and said object so as to initiate an object cutting operation;

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controlling an oscillation frequency of said drive unit as said cutting tool oscillates along said cutting axis during said object cutting operation.